Night Sky Network

Astronomy Clubs bringing the wonders of the universe to the public

Supernovae in the Lives of Stars

What is a supernova? Where does it fit in the lives of stars? Will the Sun go supernova?

About the Activity

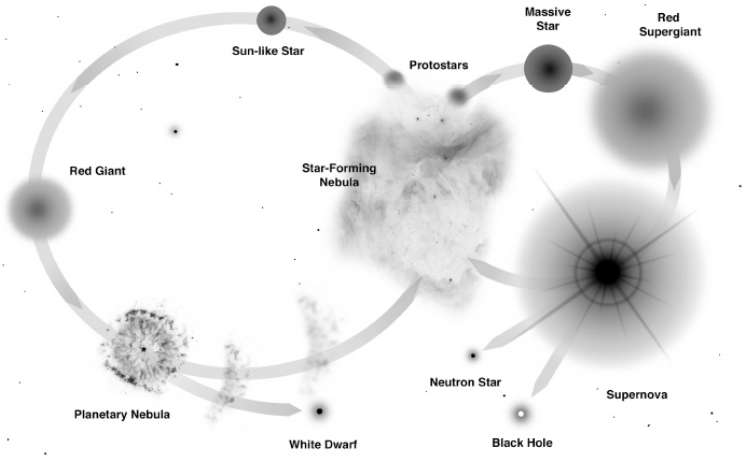
Allow visitors to discover the lifecycle of stars and when supernovae happen. Many people think the different stages in the life of a star are actually different *types* of stars, rather than just *stages* in the life of a single star.

Topics Covered

- The lifecycle of stars like our Sun compared to massive stars
- Stages in the lives of stars

Location and Timing

This activity can be used indoors or outdoors, before a star party, in a classroom, or at a club meeting. It takes about 5 to 10 minutes.



Materials Needed

- Copies of handouts and/or banner:
  Lives of Stars
- *(Optional)* Telescopes

Participants

Activities are appropriate for families with children over the age of 9, the general public, and school groups in ages 10 and up. Any number of visitors may participate.

Included in This Activity

Set Up
Detailed Activity Description
Background Information
Lives of Stars handout (double-sided)

Additional astronomy activities can be found here: http://nightsky.jpl.nasa.gov

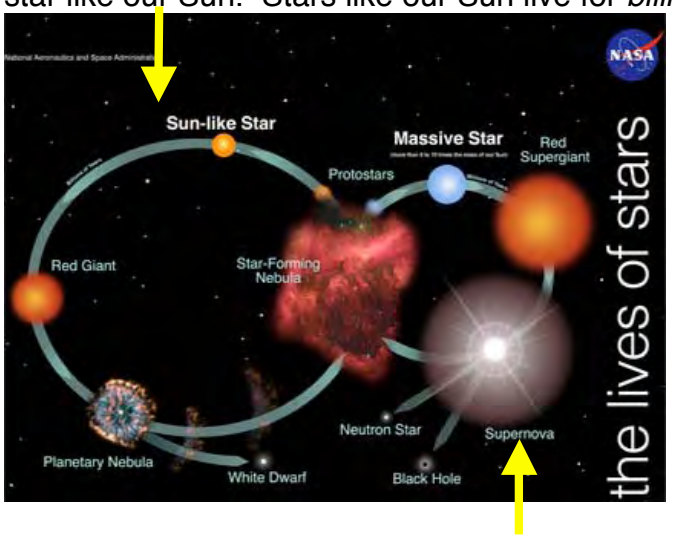
Set Up Instructions

Make copies of Lives of Stars handouts for your visitors. The presenter(s) may want a copy of the list of stars that will go supernova for reference. (Note that the "Lives of Stars" Handout has two choices: one with a dark background and one with a white background.)

Detailed Activity Description

The Lives of Stars

Leader's Role	**Participants' Role (Anticipated)**
Objective: Allow visitors to discover the lifecycle of stars and when supernovae happen.	
To say: How many have heard of a supernova? Black holes? White dwarf stars? Red giant stars? How about a planetary nebula? Who can tell me how are all these things related? Well, they are all different stages in the life of a star. Let's see what that means. *To do:* Show lifecycle banner. Pass out handouts.	Hands go up. Huh? They are all different kinds of things in the universe.
Misconception Tip: Many people think the different stages in the life of a star are actually different TYPES of stars, rather than just STAGES in the life of a single star. Like the difference between TYPES of insects (a butterfly, a bee, or a housefly) rather than the different STAGES in the life of a single type of insect. For example, a butterfly's lifecycle starts as an egg, then it becomes a caterpillar, then a pupa, then a full-grown butterfly. Its appearance changes at each stage. Stars also change their appearance as they go through stages in their lives.	

Leader's Role	**Participants' Role (Anticipated)**
To say: [referring to handouts] What do you suppose this represents? Well, THIS side shows drawings of the stages in the life of a star like our Sun. Stars like our Sun live for *billions* of years.  And THIS side shows the life of a massive star – several times the mass of the Sun. These large, hot stars only live for *millions* of years. *To do:* Let participants explore the banner and discuss each step. Walk through each step in the lifecycle of both types of stars as discussed on the back of the handout (see page 8). The steps are printed on the reverse side of the handouts.	Types of stars? Discuss.

Leader's Role	**Participants' Role (Anticipated)**
Presentation Tip: There may be a few kids (or adults) among your visitors who are familiar with some of the stages in the life of a star. Allow them to explore the handout and provide their ideas before presenting all the answers. It is important to explain that the nebula in the middle of the diagram is representative of the many nebulae in our galaxy. The blown off material from stars generally does not go back into the nebula from which the star was formed, but just adds material to other clouds of gas and dust between the stars.	
To Do: You might want to use the activity "Let's Make A Supernova" as part of your discussion: http://nightsky.jpl.nasa.gov/download-search.cfm	
To Say: So will our Sun go supernova? Why not?	No! It'll turn into a white dwarf – it's not big enough to explode.
Optional: If a telescope observing session follows the presentation: *To Say:* You can see for yourself some of the stages in the lives of stars by looking through the telescopes. Star-forming nebulae, planetary nebulae, or the remains of a supernova. How many will you find? Ask the telescope operators what they are showing you and see if it fits into the lifecycle of a star.	

A young visitor remarks, "This is what our Sun could look like in a few billion years!"

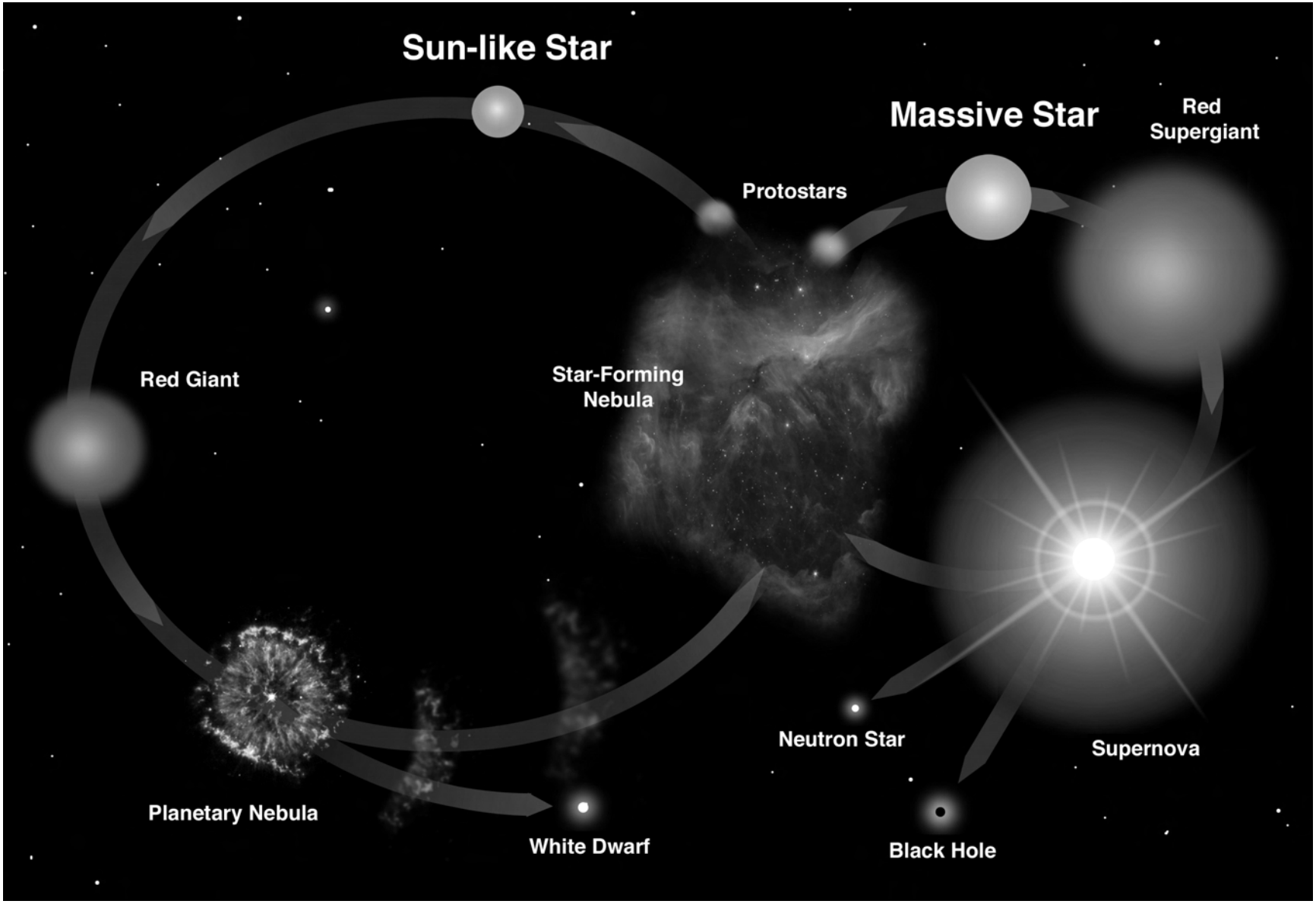
Background Information

This activity concentrates on the lives of massive stars: stars more than 8 to 10 times the mass of our Sun and the energy they generate. These are the stars that end their lives in spectacular supernova explosions called **"Type II"** supernovae.

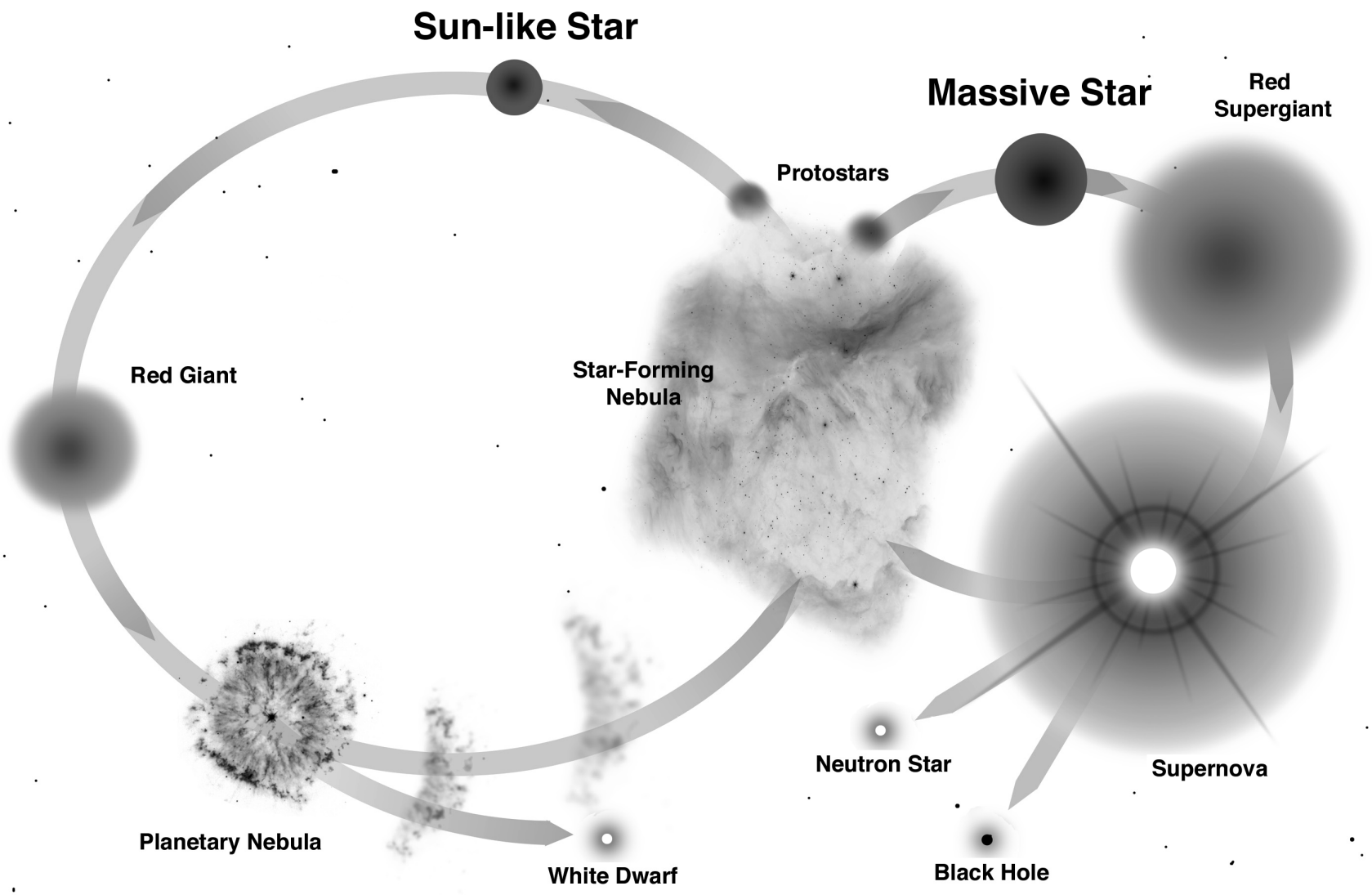
Another basic type of supernova happens when a white dwarf pulls too much material off a companion star and then explodes. This is called a **"Type 1a"** supernova. This type of supernova is not addressed in this ToolKit.

From this website, download more details about stellar lifecycles:
http://imagine.gsfc.nasa.gov/docs/teachers/lifecycles/

For more information about supernovae:
http://imagine.gsfc.nasa.gov/docs/science/know_l1/supernovae.html



the lives of stars



the lives of stars

THE LIVES OF STARS

What is a red giant, a white dwarf, or a supernova? Where do these fit into the lives of stars? Follow the arrows on the diagram and discover the stages in the life of a small Sun-like star compared to the stages in the life of a massive star (a star more than 8 to 10 times the mass of our Sun).

Stars of all sizes are born as *Protostars* from a cloud of gas and dust in our galaxy (a *Star-Forming Nebula*). When the protostar compresses under the force of gravity and its core becomes hot enough, the star begins fusing hydrogen into heavier elements in its core.

Stages in the life of a sun-like star (A life of BILLIONS of years):

Sun-like Star: For billions of years, the star remains stable, fusing hydrogen in its core.

Red Giant: After several billion years, the star uses up the hydrogen in its core, and it turns into a red giant, now mostly fusing helium.

Planetary Nebula: At this point the star goes through an unsettled stage where it starts losing its outer atmosphere in a planetary nebula which forms around the star.

On the diagram, the cycle continues from the planetary nebula back into the cloud of gas and dust. This represents the recycling of the elements created in the star back into the interstellar medium to provide material to make new stars.

White Dwarf: The leftover core of the star cools down and shrinks to a white dwarf. After billions of years, the white dwarf cools off so much that it no longer glows and becomes the dark, cold remains of the star.

Stages in the life of a massive star (A life of MILLIONS of years):

Massive Star: For millions of years, the star remains stable, fusing hydrogen in its core.

Red Supergiant: After several million years, the star uses up the hydrogen in its core and it turns into a red supergiant. The star continues to fuse atoms in its core into heavier and heavier elements until the core starts filling up with iron. Because the fusion process stops at iron, the core collapses under its own weight, no longer held up by the heat generated during fusion.

Supernova: An explosive shock wave and the energy generated from the core collapse starts moving outward, heating the surrounding layers of the star, and BOOM. Most of the star is blasted into space in a supernova explosion. On the diagram, the cycle continues from the supernova back into the cloud of gas and dust. This represents the recycling of the heavy elements created in the star and during the supernova explosion into the interstellar medium to provide the material to make new stars — and planets.

Neutron Star or Black Hole: After the explosion, the remaining core of the star turns into a neutron star or, if the core is more than three times the mass of the Sun, it turns into a black hole.

Which NASA missions study supernovae, black holes, and high-energy radiation from space?

Some of the NASA missions are:

GLAST: http://www.nasa.gov/glast

Swift: http://swift.gsfc.nasa.gov

Chandra: http://chandra.harvard.edu/

In collaboration with European Space Agency (ESA)
XMM-Newton: http://xmm.sonoma.edu

In collaboration with Japanese Aerospace Exploration Agency (JAXA)
Suzaku: http://suzaku-epo.gsfc.nasa.gov/